BIOLOGICAL EVALUATION
Western Spruce Budworm Infestation
in Southeast Idaho and Northwest Wyoming
1978

Forest Insect and Disease Management
State and Private Forestry
U. S. Forest Service
Ogden, Utah

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INTRODUCTION

For more than two decades the western spruce budworm, Choristoneura occidentalis Free., has been epidemic in mixed conifer stands in portions of southeastern Idaho and northwestern Wyoming (Figure 1). During the last decade, defoliation recorded during the annual detection survey has averaged approximately 104,000 acres. The largest amount of visible damage, amounting to 346,800 acres, was recorded in 1978 (Table 1). The most persistent and widespread outbreaks have occurred on the Bridger-Teton National Forest while the Targhee National Forest has experienced several major fluctuations. Major infestations on the Caribou National Forest have been less frequent and until this year the average yearly recorded defoliation amounted to less than 6,000 acres.

During 1978 changes in the extent and intensity of budworm defoliation occurred throughout the outbreak area. On the Targhee National Forest, approximately 47,000 acres of new infestation occurred in stands located between Teton Pass and Packsaddle Creek to the northwest.

On the Caribou National Forest, new defoliation was recorded on 38,000 acres. New infestations, recorded for the first time in the Grand Teton National Park, occur in several stands along a major travel route through the Park. In addition, the long-standing infestations on the Targhee and Bridger-Teton expanded into uninfested stands. Distinct from this expansion in area, the Targhee and Bridger-Teton infestations also significantly increased in defoliation intensity.

In addition to the annual egg mass survey conducted to provide a defoliation prediction for the 1979 season, impact data was collected from 18 selected stands. Data included standard tree and stand measurements, radial growth, top kill, and current defoliation. The data were collected and analyzed according to a procedure developed by Region 1 as part of the Canada/U.S. Spruce Budworm Program.

TECHNICAL INFORMATION

INSECT: Western spruce budworm, Choristoneura occidentalis Free.

HOST TREES: Douglas-fir, Pseudotsuga menziesii (Mirb.)

1/ By Lawrence E. Stipe, Ogden Field Office, Forest Insect and Disease Management, U. S. Forest Service, Ogden, Utah.

Subalpine fir, Abies lasiocarpa (Hook.) Nutt.

Engelmann spruce, Picea engelmanni Parry.

TYPE OF DAMAGE: Defoliation, branch and top killing and mortality of host trees.

EXTENT OF INFESTATION:

Targhee National Forest (West Division): Includes 38,000 acres along the south slope of Centennial Mountains between Cottonwood Creek and East Camas Creek (Figure 2).

Targhee National Forest (South Division): Includes 64,000 acres scattered from the north side of the Grand Canyon of the Snake River north to lower Teton Pass and northwest to Big Hole Mountains (Figure 4).

Grand Teton National Park: Includes 3,200 acres along the base of the Teton Range between Phelps Lake and Leigh Lake and between Two Ocean Lake and Lozier Hill (Figure 5).

Bridger-Teton National Forest: Includes nearly 200,000 acres located in the lower Greys River drainage, Grand Canyon of the Snake River, lower Hoback drainage and portions of the Mosquito Creek, Fall Creek and Cache Creek drainages (Figure 6 and 7).

Caribou National Forest: Includes 38,000 acres scattered throughout the Caribou Range from Mount Baldy south to Water Canyon (Figure 8).

SURVEY PROCEDURES

Insect mortality and damage were recorded on ½-inch per mile forest maps during the annual aerial detection survey by entomologists from the Ogden Field Office. From these surveys and those from previous years, 18 stands were selected for stand impact evaluations. A 5- by 10-chain grid sampling pattern was used to randomly select the plots within a given stand. Variable and fixed plots (common centers) were spaced 5 chains apart on transects 10 chains apart. Variable plot trees (5 inches dbh and larger) were recorded using a BAF of 20 and trees smaller than 5 inches were recorded on a fixed 1/300-acre (6.8 foot radius) plot. All trees regardless of size were tallied by species, size (dbh), and one or more of the following damage categories:

No defoliation (no insect damage)
Light defoliation (less than 10%)
Moderate defoliation (10 - 70%)
Heavy defoliation (greater than 70%)
Light top kill (less than 10%)
Moderate top kill (10 - 33%)
Heavy top kill (greater than 33%)
Defoliation mortality

In addition, increment cores and tree height were collected from the first five host and nonhost trees on each variable plot.

Branch samples were collected as part of a West-wide program designed to improve egg mass sampling as a predictive tool. These data are included to give an estimate of the future trend of these infestations and the level of tree damage expected. Samples were taken from permanent three-tree clusters that had been previously established in areas with budworm defoliation. These samples, consisting of two 70-cm branches, were cut from mid crown position on opposite sides of each of the three trees (six branches per cluster). These branches were individually labeled, bagged and shipped to the Forest Insect and Disease laboratory in Ogden, Utah. Each branch was carefully examined and all egg masses were removed and tallied by cluster.

RESULTS AND DISCUSSION

TARGHEE NATIONAL FOREST

The original green stand (live trees before the infestation) for the ten stands examined on the Targhee National Forest averaged 328 trees per acre (Table 2). The species composition includes Douglas-fir (71 percent), subalpine fir (18 percent), Engelmann spruce (3 percent) and lodgepole pine-aspen (8 percent). Approximately 99 percent or 299 of the 303 host trees per acre have been damaged to some extent by the budworm. Defoliation, top kill and mortality were heaviest in the understory. Nearly 36 trees per acre of the Douglas-fir understory were killed while only 3 trees per acre were killed in the 5 to 11.9-inch dbh category and no mortality occurred in the trees above 12 inches dbh. These data suggest that tree damage and mortality increase as tree size decreases. Individual stand data are summarized in Tables 3 through 12.

The actual mean periodic annual increment for trees 5 inches dbh and larger for the ten stands on the Targhee National Forest was 38.01 (cu.ft. vol/acre/yr.) for Douglas-fir, 7.6 for subalpine fir and 3.7 for spruce (Table 22). For the four years of this infestation, these figures represent an annual growth loss of 7.8 percent, 16.0 percent and 13.8 percent, respectively. Stands with high egg mass counts were generally those with the largest percentage of growth reduction. These data, not correlated by way of a rigid analyses, support the rationale that growth loss is heaviest in areas where populations and subsequent defoliation is the highest. This same relationship also holds true with degrees of defoliation and the amount of top kill observed.

Egg mass data indicate that defoliation will be, at least, moderate to heavy in most stands in the West and East Divisions on the Targhee.

No trend samples were collected during 1977 in the South Division. Since much of this infestation area was new in 1978, the populations are expected

to continue and intensify for the next few years. The mean number of egg masses per cluster increased from 16.0 in 1977 to over 23 in 1978 on the West Division and from 3 to 5.5 on the East Division. Predicted defoliation for 1979 is summarized in Tables 23, 24, and 25 for the Targhee National Forest.

GRAND TETON NATIONAL PARK

Visible new defoliation increased from 500 acres in 1977 to over 3,100 acres in 1978. Most of this increase was recorded in newly infested stands between Phelps Lake and Leigh Lake and from Two Ocean Lake to Lozier Hill.

Egg mass clusters, established in the Park, include two located on Blacktail Butte and two near Two Ocean Lake (Table 26). The mean number of egg masses per cluster increased from 15.0 in 1977 to 20.3 in 1978, and indicated defoliation will be very heavy in 1979.

BRIDGER-TETON NATIONAL FOREST

Aerial survey data for the Bridger-Teton National Forest show an almost four-fold increase in the number of acres of visible defoliation over 1977. This increase, although not fully understood, coincides with similar buildups that have occurred on adjacent portions of the Targhee and Caribou National Forests.

The eight impact stands sampled on the Bridger-Teton National Forest are summarized in Table 13. The original stocking for all size classes was 465.87 trees per acre. The stand is composed mostly of Douglas-fir (78 percent) with some subalpine fir (9 percent) and spruce (3 percent) and a nonhost component of 10 percent (lodgepole and aspen). Spruce budworm damaged all of the 416 host trees per acre. Again, defoliation, top kill and mortality were heaviest in the understory trees. Mortality of the trees above 12 inches dbh was less than one half tree per acre. Individual stand tables are found in the appendix (Tables 14 through 21).

The annual periodic increment for trees above 5 inches dbh on the Bridger-Teton ranged from 8.62 to 37.72 (cu.ft. vol/acre/yr.) (Table 22). The average annual growth loss for these eight stands was 17.3 percent for Douglas-fir. In contrast to the Targhee, growth loss in subalpine fir and spruce was well below that of Douglas-fir. This difference might be accounted for by variations in site index and habitat type.

Egg mass data was collected from 34 clusters on the Bridger-Teton (Table 27). Egg mass numbers increased two fold over 1977. The mean number of masses per cluster in 1978 was 46.3. Extreme defoliation is predicted in 1979.

CARIBOU NATIONAL FOREST

Egg mass and stand data were not collected on the Caribou due to bad weather and a lack of personnel near the end of last field season. Following two years of no visible defoliation, over 38,000 acres were detected in 1978. Much of this was in stands infested for the first time in many years. Without additional information, the trend and intensity of this infestation in 1979 is unknown. One might speculate it will continue, but fluctuations have been common on the Caribou (Table 1). This is the first time there has been an increase of this magnitude.

SURVEY COSTS SUMMARY

Aerial Survey

Aircraft - Targhee	$ 4,280.00
- Bridger-Teton (Park)	4,420.00
- Caribou	2,160.00
Observer Salary	1,530.00
Travel and per diem	450.00
	$12,840.00

Stand Impact Evaluation

Vehicles	$ 4,550.00
Field Crew Salaries	1,434.00
Equipment	350.00
Travel and per diem	4,290.00
Contributed by YACC	1,996.00
	$12,620.00

Egg Mass Evaluation

Field Crew Salaries	$ 4,360.00
Lab Crew Salaries	2,075.00
Travel and per diem	2,110.00
Equipment	350.00
Contributed by YACC (field)	450.00
Contributed by YACC (lab)	580.00
	$ 9,925.00

TOTAL SURVEY	$35,385.00

RECOMMENDATIONS

1. Forest Insect and Disease personnel should conduct aerial detection and egg mass surveys in all major infestation areas. New egg mass

clusters should be established on the Caribou National Forest and additional clusters added in Grand Teton National Park.

2. Since much of the damage is occurring in Grand Teton National Park, a VIS type flyer should be prepared to explain the cause and type of damage that can be seen along the Grand Canyon of the Snake River on the Bridger-Teton National Forest.

3. An analysis should be made to determine how damage will affect management in areas where growth loss and understory mortality are the heaviest. This should not be done with the current overstory stand in mind but with particular emphasis on how the current damage to the understory will relate to the next rotation.

4. Managers are encouraged to cooperate with researchers involved in the spruce budworm accelerated research and development program (CANUSA) by providing access and use of infested area. CANUSA is an internationally funded research project between Canada and the United States.

5. Chemical control is not recommended at this time.

6. Where damage and manager options coincide, a pilot control project could be conducted and over a limited area could reduce budworm populations for a short time.

Recommended by:

A. M. Rivas

ALFRED M. RIVAS, Director
Forest Insect and Disease Management

Approved by:

William E Murray

WILLIAM E. MURRAY, Deputy Regional Forester
State and Private Forestry

A P P E N D I X

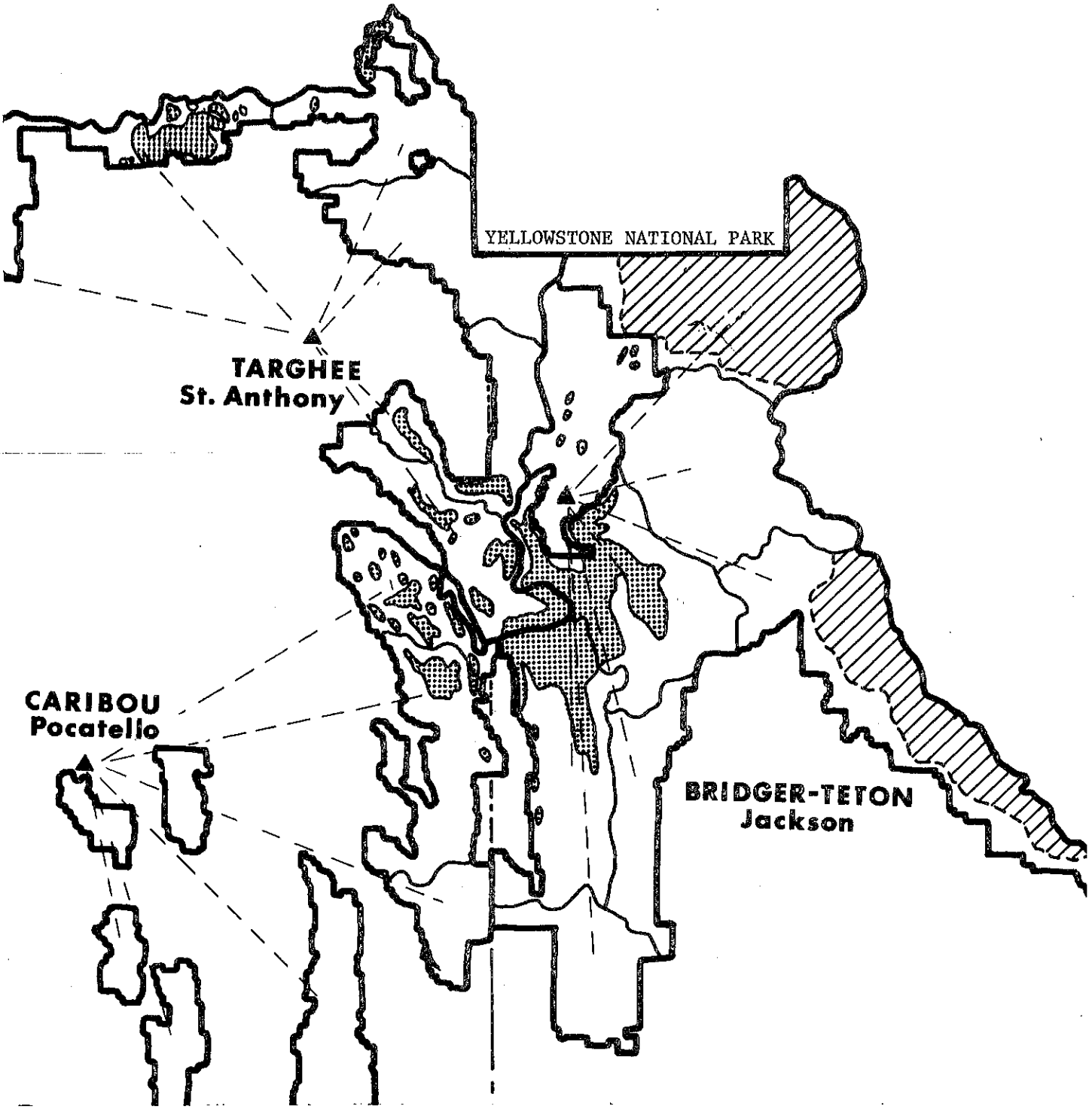

FIGURE 1. Known distribution of western spruce budworm during the last two decades on the Targhee, Bridger-Teton and and Caribou National Forests.

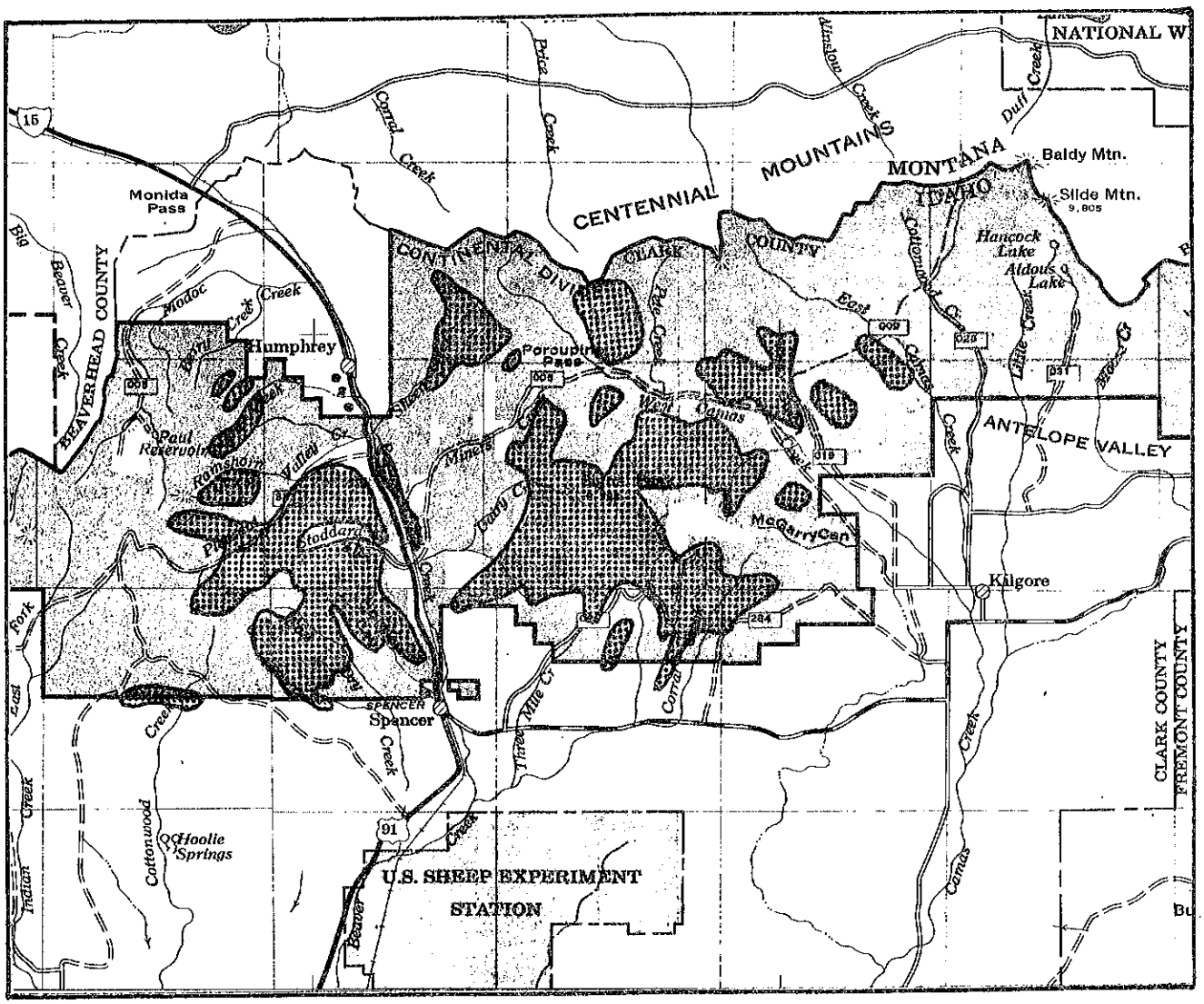

FIGURE 2. Distribution of western spruce budworm defoliation on the Targhee National Forest (West Division) 1978.

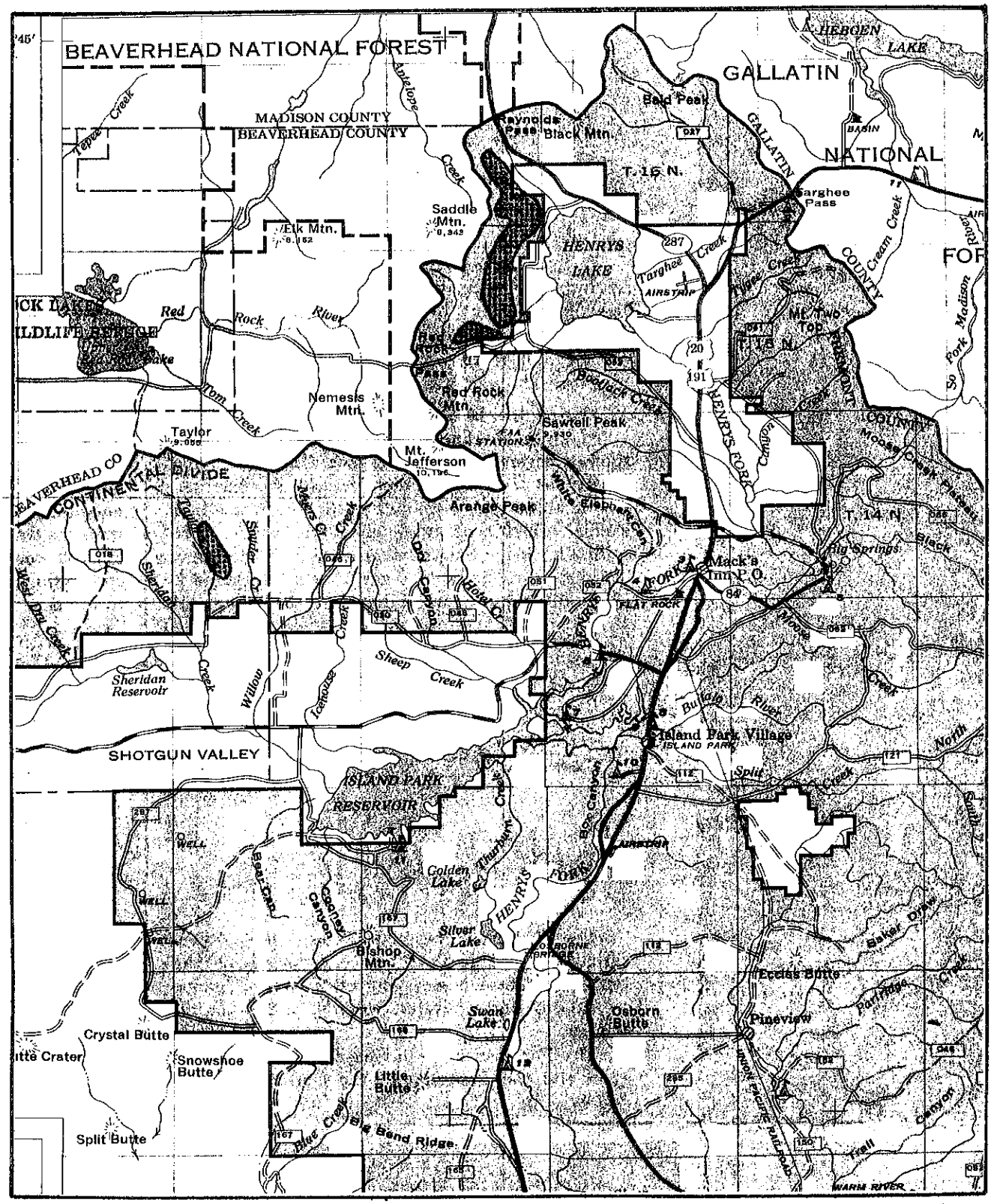

FIGURE 3. Distribution of western spruce budworm defoliation on the Targhee National Forest (East Division) 1978.

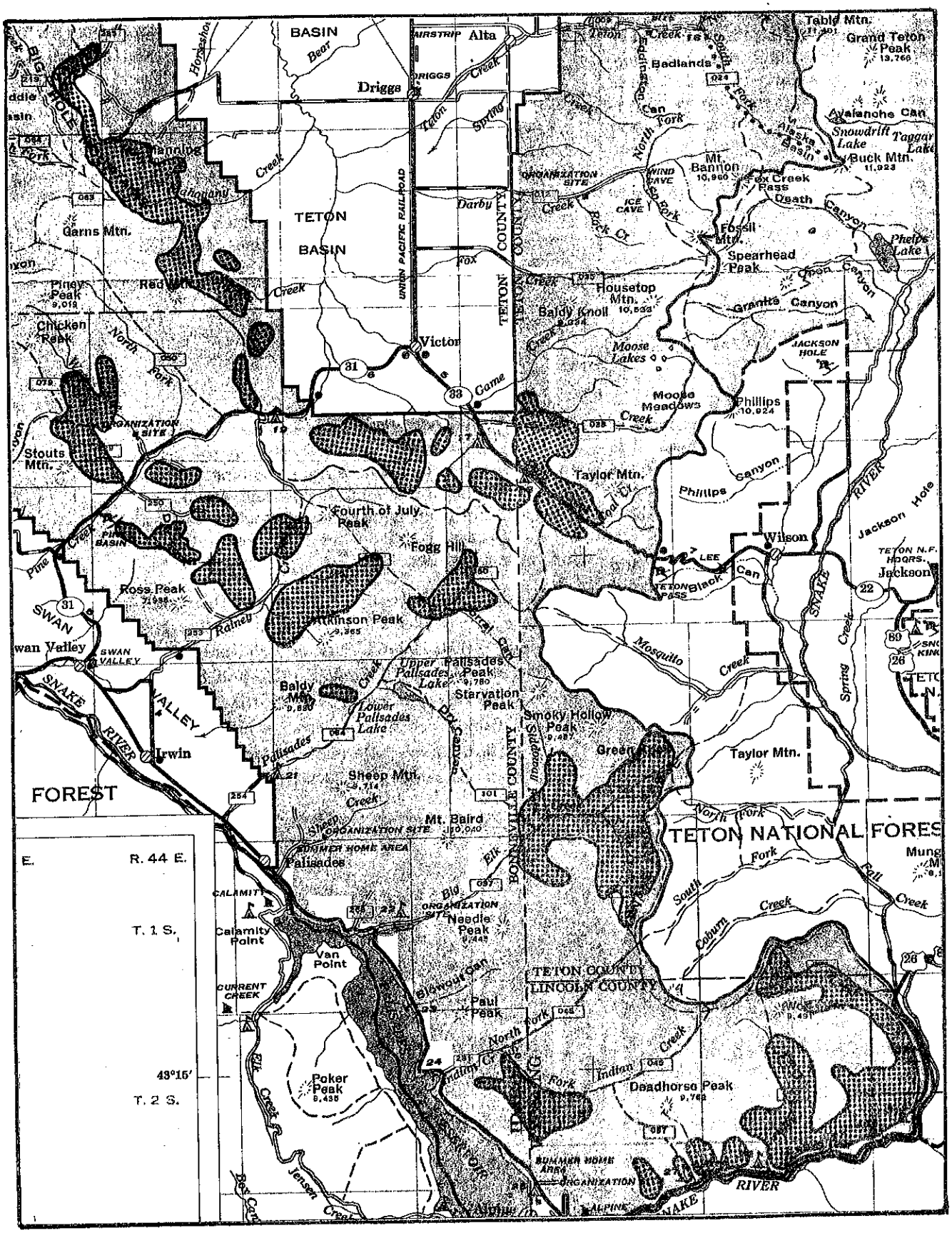

FIGURE 4. Distribution of western spruce budworm defoliation on the Targhee National Forest (South Division) 1978.

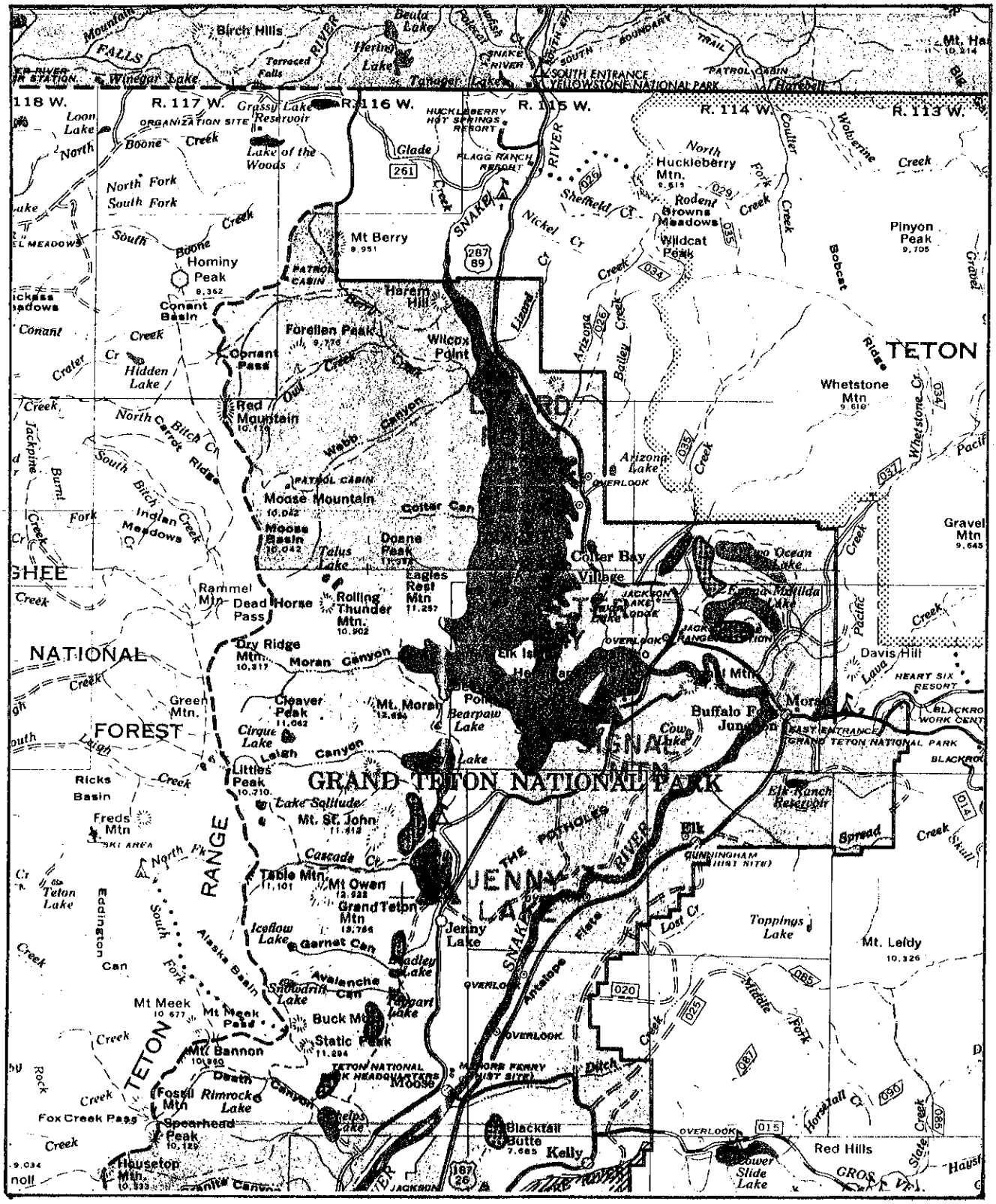

FIGURE 5. Distribution of western spruce budworm defoliation in Grand Teton National Park, 1978.

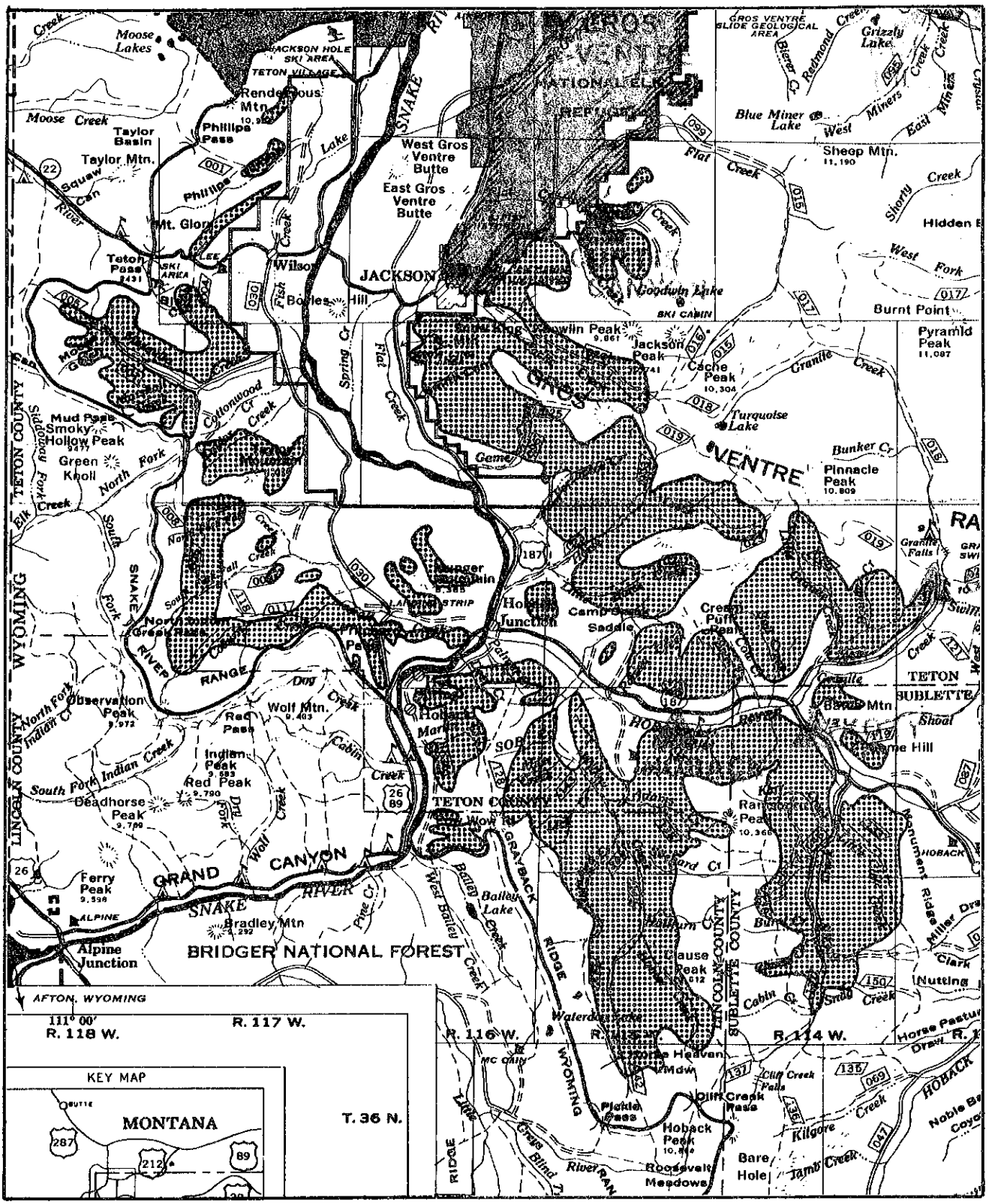

FIGURE 6. Distribution of western spruce budworm defoliation on the Bridger-Teton National Forest, 1978.

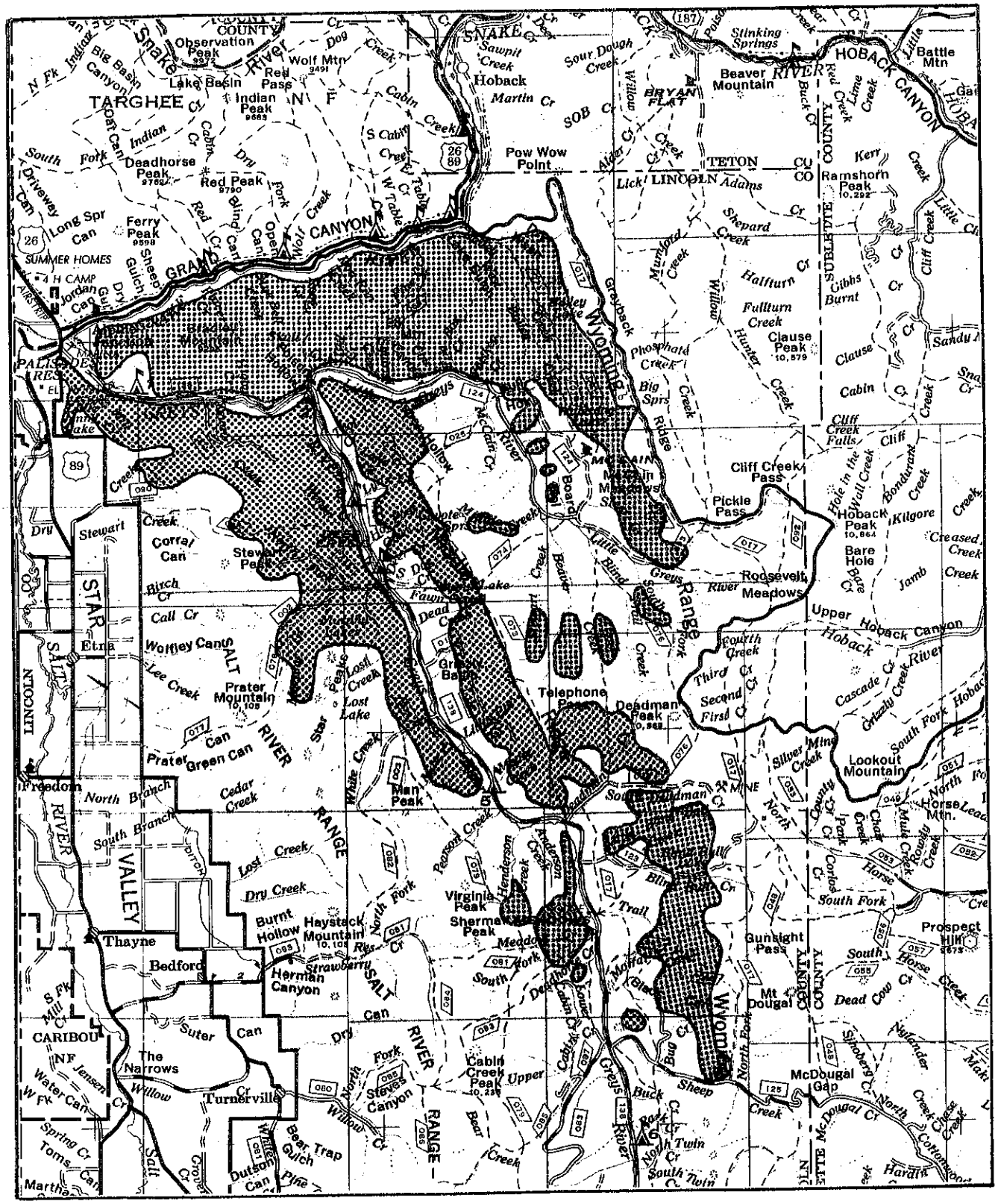

FIGURE 7. Distribution of western spruce budworm defoliation on the Bridger-Teton National Forest, 1978.

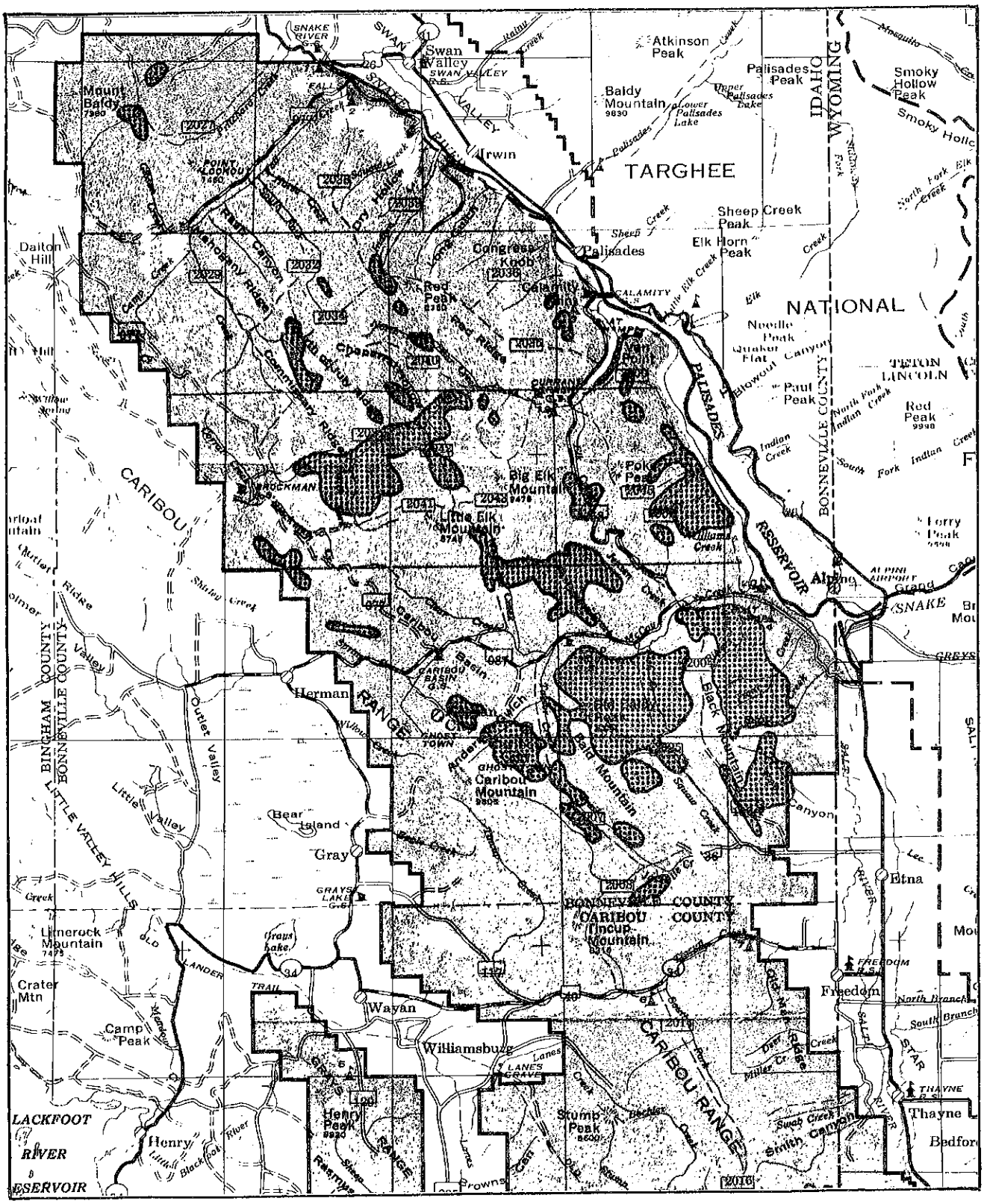

FIGURE 8. Distribution of western spruce budworm defoliation on the Caribou National Forest, 1978.

Year	ACRES DEFOLIATED BY FOREST			Total
	Targhee	Bridger-Teton[1/]	Caribou	
1965	97,900	10,000	0	107,900
1966	14,600	33,800	0	48,400
1967	10,000	54,900	100	65,000
1968	17,000	109,800	6,000	132,800
1969	1,800	80,800	500	83,100
1970	12,400	68,400	100	80,900
1971	9,800	30,600	100	40,500
1972	3,600	62,000	1,000	66,600
1973	0	0	0	0
1974	1,500	18,900	0	20,400
1975	36,900	119,200	300	156,400
1976	41,200	141,200	0	182,400
1977	13,800	52,600	0	66,400
1978	105,760	199,550	38,150	343,460

[1/] Includes Grand Teton National Park.

Table 1. Acres of western budworm-caused defoliation from 1965 to 1978 as recorded during insect aerial detection surveys in Region 4.

COMBINED TARGHEE (10 Stands)

Species /	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	134.8	--	27.7	11.6	53.7	40.5	13.5	2.4	35.6
	5 - 11.9	69.3	0.8	11.4	22.7	31.5	15.8	2.3	1.1	2.8
	12 - up	30.1	0.5	5.0	13.4	10.8	6.1	0.4	>0.1	--
Alpine fir	0 - 4.9	44.4	--	8.6	9.2	23.9	20.6	2.4	1.2	--
	5 - 11.9	12.6	--	1.3	2.9	7.4	5.1	--	--	0.3
	12 - up	2.0	--	0.8	0.7	0.4	0.3	--	--	--
Engelmann Spruce	0 - 4.9	6.8	3.0	3.1	--	--	--	--	--	--
	5 - 11.9	2.1	--	0.7	1.1	0.4	0.1	0.2	--	--
	12 - up	0.5	--	--	0.3	0.2	0.3	--	--	--
	0 - 4.9	10.2	10.2							
	5 - 11.9	13.3	13.3							
	12 - up	1.7	1.7							
STAND TOTAL		327.8	29.5	59.4	61.8	128.3	88.8	18.9	4.8	38.6

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 2. Combined stand structure and composition by damage category from ten stands on the Targhee National Forest, 1978.

VAN NOYS

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	105.00			15.00	60.00	15.00	45.00		30.00
	5 - 11.9	44.79			1.36	43.43	8.53	17.05	4.48	
	12 - up	41.74			9.53	31.57	20.86	0.24		
Alpine fir	0 - 4.9									
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
	0 - 4.9									
	5 - 11.9									
	12 - up									
STAND TOTAL		191.53			25.89	135.00	44.40	62.29	4.48	30.00

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 3. Stand structure and composition by damage category in trees per acre in Van Noys Creek on the Targhee National Forest, 1978.

WEST RATTLESNAKE CREEK

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	180.00		120.00	15.00	45.00	15.00			
	5 - 11.9	105.04		15.26	51.64	35.66	11.33			2.48
	12 - up	31.62		4.47	18.67	8.48	1.08	0.87		
Alpine fir	0 - 4.9									
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
	0 - 4.9									
	5 - 11.9									
	12 - up									
STAND TOTAL		316.66		139.73	85.31	89.14	27.41	0.87	--	2.48

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 4. Stand structure and composition by damage category in trees per acre in west Rattlesnake Creek on the Targhee National Forest, 1978.

EAST THREE MILE

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	75.00		45.00	30.00	--	30.00			
	5 - 11.9	92.16		25.70	40.04	24.95	3.83	--	--	1.46
	12 - up	33.91	.87	12.20	17.16	3.68	2.57			
Alpine fir	0 - 4.9	15.00		15.00						
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Lodgepole Pine	0 - 4.9									
	5 - 11.9	5.93	5.93							
	12 - up	1.54	1.54							
STAND TOTAL		223.53	8.34	97.90	87.19	28.64	36.40			1.46

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 5. Stand structure and composition by damage category in trees per acre in East Three Mile Creek on the Targhee National Forest, 1978.

PLEASANT VALLEY

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	240.00				120.00	90.00			120.00
	5 - 11.9	114.55		7.60	32.19	69.12	36.65	3.97	6.29	5.64
	12 - up	23.52		0.70	15.37	7.45	11.84			
Alpine fir	0 - 4.9									
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
	0 - 4.9									
	5 - 11.9									
	12 - up									
STAND TOTAL		378.07	--	8.30	47.56	196.57	138.49	3.97	6.29	125.64

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 6. Stand structure and composition by damage category in trees per acre in Pleasant Valley on the Targhee National Forest, 1978.

KELLY CREEK

Species	DBH Size Class (inches)	Original Green [1]	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	81.82				54.55	54.55			
	5 - 11.9	31.97	2.35			29.61				
	12 - up	36.26	2.24	0.55	10.27	20.67	3.95	0.18		
Alpine fir	0 - 4.9	81.82				54.55	81.82			
	5 - 11.9	19.08				11.87	7.21			
	12 - up	5.70		1.27	2.78	0.65	1.01			
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Lodgepole Pine	0 - 4.9									
	5 - 11.9									
	12 - up	4.39	4.39							
STAND TOTAL		261.03	8.98	1.82	13.05	171.89	148.53	0.18		

[1] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 7. Stand structure and composition by damage category in trees per acre in Kelly Creek on the Targhee National Forest, 1978.

TIMBER CREEK

Species /	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	240.00	--	36.00	24.00	60.00	48.00	60.00	24.00	84.00
	5 - 11.9	78.22	1.73	26.27	28.44	6.56	47.51	2.31	--	13.99
	12 - up	22.09	1.07	11.88	7.96	1.17	5.41	1.36	--	--
Alpine fir	0 - 4.9	228.00		12.00	60.00	156.00	108.00	24.00	12.00	
	5 - 11.9	46.14		3.59	3.29	39.25	35.70			
	12 - up	3.58			2.48	1.10	1.88			
Engelmann Spruce	0 - 4.9	--								
	5 - 11.9	4.69			1.11	3.58	1.11	2.47		
	12 - up	1.51				1.51	1.51			
Lodgepole Pine and Aspen	0 - 4.9	72.00	72.00							
	5 - 11.9	29.75	29.75							
	12 - up	1.02	1.02							
STAND TOTAL		726.99	105.57	89.74	127.28	269.17	249.12	90.14	36.00	97.99

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 8. Stand structure and composition by damage category in trees per acre in Timber Creek on the Targhee National Forest, 1978.

GILLAN CREEK

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	195.00		30.00	--	75.00	60.00	30.00		90.00
	5 - 11.9	98.06		16.81	28.14	48.49	38.53			4.62
	12 - up	38.35		5.14	25.61	7.60	8.83	1.21		
Alpine fir	0 - 4.9									
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Aspen	0 - 4.9									
	5 - 11.9	2.90	2.90							
	12 - up									
STAND TOTAL		334.31	2.90	51.94	53.75	131.09	107.36	31.21	--	94.62

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 9. Stand structure and composition by damage category in trees per acre in Gillan Creek on the Targhee National Forest, 1978.

RED ROCK PASS

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	45.00				45.00	15.00			
	5 - 11.9	65.65	1.49	15.86	28.13	20.18	11.55			
	12 - up	34.87	0.34	7.79	17.59	9.15	3.54	0.54	0.18	
Alpine fir	0 - 4.9									
	5 - 11.9	2.86			2.86		2.86			
	12 - up									
Engelmann Spruce	0 - 4.9	45.00	30.00	15.00						
	5 - 11.9	16.60		7.05	9.55					
	12 - up	3.44			3.44		1.15			
Aspen	0 - 4.9									
	5 - 11.9	1.66	1.66							
	12 - up									
STAND TOTAL		215.08	33.49	45.69	61.57	74.33	34.11	0.54	0.18	

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 10. Stand structure and composition by damage category in trees per acre in Red Rock Pass on the Targhee National Forest, 1978.

UPPER KELLY CREEK

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	28.57		14.29		14.29	14.29			
	5 - 11.9	28.08		6.89	4.81	16.38				
	12 - up	31.36		7.35	9.14	14.87	3.06			
Alpine fir	0 - 4.9	71.43		42.86	--	28.57				
	5 - 11.9	22.18		9.16	6.05	6.97	1.78			
	12 - up	6.20		5.32	0.88					
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Lodgepole Pine	0 - 4.9	14.29	14.29							
	5 - 11.9	7.25	7.25							
	12 - up	6.75	6.75							
STAND TOTAL		216.11	28.29	85.86	20.88	81.07	19.13			

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 11. Stand structure and composition by damage category in trees per acre in upper Kelly Creek on the Targhee National Forest, 1978.

DOG CREEK

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	157.89		31.58	31.58	63.16	63.16			31.58
	5 - 11.9	34.06	2.01		11.79	20.26				
	12 - up	6.83		0.28	2.86	3.70				
Alpine fir	0 - 4.9	47.37		15.79	31.58		15.79			
	5 - 11.9	35.71			16.92	16.24	3.92		1.69	2.55
	12 - up	4.74		1.04	1.10	2.59				
Engelmann Spruce	0 - 4.9	15.79		15.79						
	5 - 11.9									
	12 - up									
Lodgepole Pine	0 - 4.9	15.79	15.79							
	5 - 11.9	85.84	85.84							
	12 - up	3.75	3.75							
STAND TOTAL		407.77	107.39	64.48	95.83	105.95	82.87	--	1.69	34.13

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 12. Stand structure and composition by damage category in trees per acre in Dog Creek on the Targhee National Forest, 1978.

COMBINED BRIDGER-TETON (8 Stands)

Species	DBH Size Class / (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	264.92		11.45	38.38	180.96	73.05	3.85	--	32.16
	5 - 11.9	86.30		2.93	18.94	57.91	20.49	0.78	--	3.99
	12 - up	14.17		0.15	3.90	9.65	2.29	0.22	0.20	0.30
Alpine fir	0 - 4.9	19.45		3.60	10.13	5.72	5.48	--	--	
	5 - 11.9	21.91		1.94	4.16	15.14	8.63	1.12	--	
	12 - up	1.87		0.07	0.33	1.36	0.33	0.19	--	
Engelmann Spruce	0 - 4.9	5.38		--	1.63	3.75	1.88			
	5 - 11.9	2.11		0.77	1.15	0.19	--			
	12 - up	0.72		--	0.43	0.29	--			
	0 - 4.9	26.69	26.69							
	5 - 11.9	18.48	18.48							
	12 - up	3.87	3.87							
STAND TOTAL		465.87	49.04	20.91	79.05	274.97	112.15	6.16	0.20	36.45

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 13. Combined stand structure and composition by damage category from eight stands on the Bridger-Teton National Forest, 1978.

SQUAW CREEK

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	180.00		30.00	45.00	75.00	45.00			30.00
	5 - 11.9	45.70			3.09	25.68	4.56	2.21		16.94
	12 - up	32.11		1.23	4.22	25.27	6.35		0.65	1.39
Alpine fir	0 - 4.9	15.00				15.00	15.00			
	5 - 11.9	24.78				24.78	10.62			
	12 - up	0.84				0.84	0.84			
Engelmann Spruce	0 - 4.9	30.00				30.00	15.00			
	5 - 11.9	7.66			6.14	1.52				
	12 - up	4.07			2.87	1.20				
	0 - 4.9	—								
	5 - 11.9	22.01	22.01							
	12 - up	3.20	3.20							
STAND TOTAL		365.37	25.21	31.23	61.32	199.28	97.37	2.21	0.65	48.33

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 14. Stand structure and composition by damage category in trees per acre in Squaw Creek on the Bridger-Teton National Forest, 1978.

TRAIL CREEK

Species	DBH Size Class (inches)	Original[1] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	120.00		30.00	15.00	60.00	15.00			15.00
	5 - 11.9	12.61				9.17	2.54			3.44
	12 - up	7.74				7.63	0.81			0.10
Alpine fir	0 - 4.9	15.00				15.00				
	5 - 11.9	49.74				49.74	14.52			
	12 - up	6.73				5.80	0.52	0.54		0.94
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Lodgepole Pine and Aspen	0 - 4.9	15.00	15.00							
	5 - 11.9	26.50	26.50							
	12 - up	9.88	9.88							
STAND TOTAL		263.19	51.38	30.00	15.00	147.34	33.39	0.54	--	19.48

[1] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 15. Stand structure and composition by damage category in trees per acre in Trail Creek on the Bridger-Teton National Forest, 1978.

PRITCHARD PASS

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	91.30			52.17	39.13	13.04			
	5 - 11.9	39.37		9.98	22.79	6.61				
	12 - up	6.01			2.03	3.98	0.71			
Alpine fir	0 - 4.9	78.26		13.04	65.22		13.04			
	5 - 11.9	28.31		10.39	17.92		2.26			
	12 - up	2.61			2.61					
Engelmann Spruce	0 - 4.9	13.04			13.04					
	5 - 11.9	9.21		6.13	3.08					
	12 - up									
Lodgepole Pine	0 - 4.9	91.30	91.30							
	5 - 11.9	58.91	58.91							
	12 - up	4.89	4.89							
STAND TOTAL		423.21	155.11	39.54	178.86	49.72	29.06			

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 16. Stand structure and composition by damage category in trees per acre in Pritchard Pass on the Bridger-Teton National Forest, 1978.

BRYAN FLAT

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	162.50			12.50	137.50	25.00			12.50
	5 - 11.9	59.60			7.80	51.80	26.83			
	12 - up	7.65			1.03	6.62	1.37	0.13		
Alpine fir	0 - 4.9									
	5 - 11.9	7.80				7.80	2.79			
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up	1.69			0.54	1.15				
Lodgepole Pine and Aspen	0 - 4.9	12.50	12.50							
	5 - 11.9	22.12	22.12							
	12 - up	9.00	9.00							
STAND TOTAL		282.86	43.62	--	21.87	204.87	55.99	0.13	--	12.50

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 17. Stand structure and composition by damage class in trees per acre in Bryan Flat on the Bridger-Teton National Forest, 1978.

WEST BAILEY CREEK

Species	DBH Size Class (inches)	Original Green [1]	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	94.74		31.58	31.58	31.58	15.79			
	5 - 11.9	27.68		1.39	3.19	23.10	8.48			
	12 - up	19.19			10.19	9.00	0.87	1.60	0.94	
Alpine fir	0 - 4.9	47.37		15.79	15.79	15.79	15.79			
	5 - 11.9	57.25		5.13	10.55	36.21	38.81	8.92		
	12 - up	4.26				4.26	1.25	0.98		
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Lodgepole Pine	0 - 4.9	94.74	94.74							
	5 - 11.9	10.94	10.94							
	12 - up	3.96	3.96							
STAND TOTAL		360.12	109.64	53.89	71.29	119.95	80.99	11.50	0.94	

[1] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 18. Stand structure and composition by damage category in trees per acre in West Bailey Creek on the Bridger-Teton National Forest, 1978.

DEER CREEK

Species /	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	360.00			105.00	195.00	120.00			60.00
	5 - 11.9	191.53		12.06	89.48	89.99	24.01			
	12 - up	4.51			2.98	1.52				
Alpine fir	0 - 4.9									
	5 - 11.9	7.43			4.83	2.60	2.66			
	12 - up	0.55		0.55						
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
Lodgepole Pine	0 - 4.9	--								
	5 - 11.9	7.33	7.33							
	12 - up	--								
STAND TOTAL		571.34	7.33	12.61	202.29	289.11	146.68	--	--	60.00

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 19. Stand structure and composition to damage category in trees per acre in Deer Creek on the Bridger-Teton National Forest, 1978.

GAME CREEK

Species /	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	315.79			15.79	189.47	110.53	15.79		94.74
	5 - 11.9	158.90			29.38	118.01	38.98	4.05		11.52
	12 - up	27.40			9.20	15.98	7.64			0.91
Alpine fir	0 - 4.9									
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
	0 - 4.9									
	5 - 11.9									
	12 - up									
STAND TOTAL		502.09	--	--	54.37	323.46	157.14	19.84	--	107.16

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 20. Stand structure and composition by damage category in trees per acre in Game Creek on the Bridger-Teton National Forest, 1978.

SNOW KING

Species	DBH Size Class (inches)	Original[1/] Green	Remaining Green	Light Def.	Moderate Def.	Heavy Def.	Light Top Kill	Moderate Top Kill	Heavy Top Kill	Mortality
Douglas-fir	0 - 4.9	795.00			30.00	720.00	240.00	15.00		45.00
	5 - 11.9	155.50			16.58	138.92	58.49			
	12 - up	8.72			1.55	7.17	0.54			
Alpine fir	0 - 4.9									
	5 - 11.9									
	12 - up									
Engelmann Spruce	0 - 4.9									
	5 - 11.9									
	12 - up									
	0 - 4.9									
	5 - 11.9									
	12 - up									
STAND TOTAL		959.21	--	--	48.13	866.08	299.03	15.00	--	45.00

[1/] The original green stand totals represent the number of trees per acre and not the total of the individual damage categories since each tree can have more than one damage rating.

Table 21. Stand structure and composition by damage category in trees per acre in Snow King on the Bridger-Teton National Forest, 1978.

Forest/Location	Douglas-fir		Subalpine fir		Spruce	
	PAI[1/]	% Loss	PAI	% Loss	PAI	% Loss
Targhee West						
Van Noys	37.98	16.4				
West Rattlesnake	58.08	2.6				
East Three Mile	40.20	2.2				
Pleasant Valley	40.37	14.3				
Targhee East						
Kelly Creek	34.57	2.2	11.40	6.2		
Timber Creek	21.94	17.5	8.61	17.9	1.60	24.4
Gillan Creek	45.78	10.1				
Red Rock Pass	34.52	3.1	0.89	38.2	5.80	3.1
Upper Kelly Creek	28.66	2.0	9.58	1.8		
Targhee South						
Dog Creek	No Samples					
Combined Targhee	38.01	7.8	7.6	16.0	3.7	13.8
Bridger-Teton						
Squaw Creek	19.6	25.1	5.76	0	5.09	0
Trail Creek	8.62	4.9	18.57	5.0		
Pritchard Pass	16.50	1.0	9.58	2.5	1.70	0
Bryan Flat	26.50	9.8	3.20	8.1		
West Bailey Creek	13.87	6.4	9.15	21.6		
Deer Creek	37.72	56.7	2.26	0		
Game Creek	No Samples					
Snow King	No Samples					
Combined Bridger-Teton	20.5	17.3	8.1	6.2	3.4	0

[1/] Periodic annual increment.

Table 22. Summary of radial growth and percent growth loss caused by the spruce budworm on the Targhee and Bridger-Teton National Forests.

TARGHEE NATIONAL FOREST (WEST DIVISION)

CLUSTER LOCATION	# Egg Masses Per Cluster			Predicted (1979)	
	1976	1977	1978	Def. %	Damage Category
Allan Canyon	9	22	18	36	Heavy
Beacon Springs	56	60	89	96	Very Heavy
Bear Trap Creek	1	0	0	--	--
Corral Creek	11	2	21	36	Heavy
Cottonwood Creek	0	0	0	0	--
East Dairy Creek	60	54	62	76	Very Heavy
East Three Mile Creek	36	15	24	41	Heavy
Little Creek	0	2	1	21	Light
McGarry Canyon	0	4	10	28	Heavy
Northeast Miners Creek	2	1	6	25	Moderate
Northeast Spring Creek	3	0	5	25	Moderate
Petes Creek	2	0	6	26	Moderate
Picnic Hollow	47	30	22	45	Heavy
Pleasant Valley Creek	83	48	65	76	Very Heavy
Pocatello Butte	20	24	67	74	Very Heavy
Polks Pit	87	45	66	81	Very Heavy
Porcupine Pass	14	6	15	32	Heavy
Saw Creek	0	0	0	0	--
Spring Creek Ridge	3	30	24	43	Heavy
Stoddard Creek	43	11	15	35	Heavy
Three Mile Creek	3	0	6	25	Moderate
Upper Little Creek	0	0	1	21	Light
Van Noy Canyon	46	16	27	44	Very Heavy
West Camas Creek	3	3	11	29	Heavy
West Dairy Creek	42	28	10	36	Heavy
West Dry Creek	1	0	2	22	Light
White Pine Canyon	86	29	66	83	Very Heavy
Mean	24.4	16.0	23.7	41.3	Heavy

Table 23. Egg mass trend by cluster for 1976, 1977, and 1978, predicted defoliation level (%) and predicted damage category for 1979 on the West Division, Targhee National Forest.

TARGHEE NATIONAL FOREST (East Division)

CLUSTER LOCATION	# Egg Masses Per Cluster			Predicted (1979)	
	1976	1977	1978	Def. %	Damage Category
Blue Creek	0	0	0	--	--
Dry Creek	0	1	3	23	Moderate
Dry Fork	1	1	9	28	Heavy
Jessey Creek	0	2	10	27	Moderate
Keg Creek	2	1	4	24	Moderate
Kelly Creek	19	12	24	41	Heavy
Lower 191	2	0	4	24	Moderate
Lower Dry Creek	2	2	0	--	--
Lower Targhee Creek	7	1	7	26	Heavy
Lower Willow Creek	NS[1/]	0	2	22	Light
Raynold's Pass	26	13	23	38	Moderate
Red Rock Pass	6	5	6	26	Moderate
Sawtell Road	0	--	5	24	Moderate
Targhee Creek	2	1	1	21	Light
Taylor Creek	--	0	1	21	Light
Timber Creek	59	18	NS	--	--
Twin Creek	--	3	1	21	Light
Upper 191	5	3	3	23	Moderate
Upper Blue Creek	1	4	2	22	Light
Upper Dry Fork	5	2	3	23	Moderate
Upper Kelly Creek	7	1	20	39	Heavy
Upper Red Rock Pass	2	0	1	21	Light
Upper Targhee Creek	4	3	0	--	--
Upper Sawtell Road	0	0	0	--	--
Willow Creek	1	2	2	22	Light
Mean	6.1	3.0	5.5	24.9	Moderate

[1/] No sample collected.

Table 24. Egg mass trend by cluster for 1976, 1977, and 1978, predicted defoliation level (%) and predicted damage category for 1979 on the East Division, Targhee National Forest.

TARGHEE NATIONAL FOREST (South Division)

CLUSTER LOCATION	# Egg Masses Per Cluster			Predicted (1979)	
	1976	1977	1978	Def. %	Damage Category
Lower Fleming Creek	No Samples	No Samples	5	25	Moderate
Mahogany Canyon			0	0	--
Mike Spencer Canyon			25	44	Very Heavy
Porcupine Creek			1	22	Light
Pole Canyon			10	29	Heavy
Ramey Canyon			3	23	Moderate
Squaw Canyon			50	60	Very Heavy
Trail Canyon			30	47	Very Heavy
Upper Fleming Creek			7	27	Heavy
Mean			14.6	33.0	Heavy

Table 25. Egg mass trend by cluster for 1976, 1977, and 1978, predicted defoliation level (%) and predicted damage category for 1979 on the South Division, Targhee National Forest.

GRAND TETON NATIONAL PARK

CLUSTER LOCATION	# Egg Masses Per Cluster			Predicted (1979)	
	1976	1977	1978	Def. %	Damage Category
Pilgrim Creek	NS[1/]	NS	13	30	Heavy
Two Ocean Lake	NS	NS	16	36	Heavy
North Blacktail Butte	NS	17	23	39	Heavy
South Blacktail Butte	NS	13	29	57	Very Heavy
Mean	--	15.0	20.3	40.5	Very Heavy

[1/] No sample collected.

Table 26. Egg mass trend by cluster for 1976, 1977, and 1978, predicted defoliation level (%) and predicted damage category for 1979 in Grand Teton National Park.

BRIDGER-TETON NATIONAL FOREST

CLUSTER LOCATION	# Egg Masses Per Cluster			Predicted (1979)	
	1976	1977	1978	Def. %	Damage Category
Astoria Hot Springs	28	2	13	30	Heavy
Bull Hollow	25	4	43	52	Very Heavy
Deer Creek	27	21	91	87	Very Heavy
Fall Creek	29	29	29	47	Very Heavy
Game Creek	62	23	54	73	Very Heavy
Higby Creek	30	18	16	36	Heavy
Horse Creek	61	14	3	23	Moderate
Lower Cache Creek	38	34	2	22	Light
Lower Leeks Canyon	23	24	127	100	Very Heavy
Mill Creek	10	32	69	71	Very Heavy
Miller Creek	49	2	66	83	Very Heavy
North Fork Murphy Creek	10	21	43	56	Very Heavy
Palmer Creek	11	2	28	46	Very Heavy
Porcupine Creek	58	78	80	92	Very Heavy
Radio Point	58	56	56	66	Very Heavy
Rogers Gulch	28	23	32	49	Very Heavy
Roos Creek	59	11	67	73	Very Heavy
Snow King	78	57	39	58	Very Heavy
Squaw Creek	23	28	39	51	Very Heavy
Twin Creek Ranch	27	28	88	91	Very Heavy
Upper Cache Creek	30	1	21	38	Heavy
Upper Leeks Canyon	77	58	NS[1/]	--	--
Upper West Bailey Creek	53	23	65	86	Very Heavy
West Bailey Creek	43	8	79	83	Very Heavy
Willow Creek	38	12	61	73	Very Heavy
Wilson Canyon	83	69	89	85	Very Heavy
Berts Hollow	NS	16	44	59	Very Heavy
Cabin Creek	NS	6	2	22	Light
East Table Creek	NS	23	40	51	Very Heavy
Grizzly Basin	NS	--	3	23	Moderate
Martin Creek	NS	56	NS	--	--
Near Dog Creek	NS	7	8	28	Heavy
Red Creek	NS	6	24	42	Heavy
Stinking Springs	NS	30	64	81	Very Heavy
Trail Creek	NS	5	30	58	Very Heavy
Upper Porcupine Creek	NS	41	59	74	Very Heavy
Mean	40.7	23.3	46.3	59.6	Very Heavy

[1/] No sample collected.

Table 27. Egg mass trend by cluster for 1976, 1977, and 1978, predicted defoliation level (%) and predicted damage category for 1979 on the Bridger-Teton National Forest.